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CHILD DEVELOPMENT

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BODY SIZE IN INFANCY AND CHILDHOOD: A COMPARATIVE STUDY OF DATA FROM OKINAWA, FRANCE, SOUTH AFRICA, AND NORTH AMERICA

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This paper focuses attention upon racial differences in body size during the first decade of life. It brings together findings from studies on Okinawans; South African Bantu-speaking Negroes; North American Negroes; American Chinese and Japanese residents of California; Alaskan Eskimos; Mexicans living in California, Texas and Mexico; Navaho and Pueblo Indians of New Mexico and Arizona; European Whites living in Marseilles, France; and North American Whites of the United States and Canada.

The writer's objective is twofold: to add to our knowledge of racial differences in childhood, and to aid in bringing teachers and writers on racial differences abreast of the known facts. Knowledge of racial differences is enhanced in part by "the accumulation and analysis of original anthropometric data" and in part by "compilation and synthesis of existing studies" (30, p. 1). The present paper is primarily the fruition of research activity of the latter type. It colligates the results from more than fifty investigations and attempts to strengthen our working foundation of fact on racial differences in childhood.

It is hoped that teachers and writers will find the paper a "serviceable source" on the problem of childhood racial differences. Too frequently in contemporary child growth literature this problem is treated erroneously or discussed in unnecessarily indefinite language. As an example of flatly erroneous statement, the following is taken in slightly veiled form from a 1946 textbook: During childhood, races differ very little in body size; it is *not until puberty* that racial differences are manifested.

The immediate spur to preparation of this paper arose from a recently reported study by Newman and Eng (37). Besides presenting an original analysis of anthropometric data collected on Okinawans in 1945, these authors compared Okinawa children with Japanese children. Interest in this particular comparison followed from an early period of similar racial history. To quote: "It is probable that the first inhabitants [of Okinawa] were Ainu-like people from the main Japanese islands. In the first or second millenium B.C., Southern Mongoloid people entered Japan, presumably via Korea, and pushed south. . . . There is no evidence that later arrivals in Japan" affected Okinawa (37, p. 152). In other words, present-day Okinawans have "higher proportions of Ainu and Southern

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Mongoloid than the Japanese themselves" and lack "the Northern Mongoloid strains later entering Japan" (37, p. 153).

The Newman and Eng findings merit alignment with findings on children of a number of ethnic groups. They would fall far short of their potential usefulness to those interested in child growth if no one discharged the task of setting them in a broad comparative framework.

Birth

Newman and Eng report averages for weight, stature, and head circumference based upon measurements of 56 Okinawa newborn infants. In Table 1 these averages are brought into juxtaposition with averages for North American infants of Negro, Mexican, Japanese and White ancestry.

The Negroid value for weight is the combined mean from studies by Anderson, Brown and Lyon (1); Bakwin (2); Baldwin (4); Bivings (5); Duffield, Parker and Baumgartner (10); Dunham, Jenss and Christie (11); Meyer (34); Michelson (36); and Pasamanick (39). The Negroid stature value is that obtained from two discrepant averages, one reported by Meyer (34) on 1,027 infants born at Baltimore, Maryland, and the other by Pasamanick (39) on 35 infants born at New Haven, Connecticut. Goldstein (14) recently made available the weight and stature means for neonates of Mexican parentage; these are based upon data obtained partly in San Antonio, Texas, and partly in Guanajuato, Mexico. Unfortunately, published research to date does not include averages for head circumference on North American newborns of either Negro or Mexican descent. The weight, stature, and head girth values for Mongoloids are taken from Ito (21), and represent neonates of Japanese parentage born 1932-35 at Los Angeles, California.

For North American White infants, it was possible to draw materials from numerous investigations. Large samples were amassed on all three measurements; to wit, over 10,000 newborns on stature (see 30, p. 14), approximately 5,000 on head circumference (see 31, p. 56), and over 100,000 on weight (1, 3, 5, 6, 8, 10, 11, 12, 15, 16, 18, 32, 34, 42, 43, 47, 51, 52, 53).

Table 1 supports the following findings:

1. Mean weight is appreciably less for Okinawa newborn infants than for newborn infants of North America. Specifically, the Okinawa infants are lighter than the White infants by 0.60 kg. (1.3 lb.), lighter than the infants of Japanese ancestry by 0.44 kg. (1.0 lb.), and lighter than the Negro and Mexican infants by 0.40 kg. and 0.37 kg. respectively. In no instance—for rejection of the null hypothesis at the 1 per cent level of confidence—is it required that the difference exceed 0.20 kg.

2. Okinawa neonates tend to be shorter in stature than North American neonates of White, Mexican and Japanese lineage, but not shorter than North American Negro neonates. More explicitly, results from tests of

statistical significance are in accord with the inference that in relation to Okinawans, North American Negroes are shorter,[1] and North American Japanese, Mexicans and Whites longer. With one exception the significance ratios exceed the critical values for confidence at the 1 per cent level.

TABLE 1

BODY SIZE MEANS ON FIVE GROUPS OF NEWBORN INFANTS

Each mean represents infants of both sexes.

Group	*Weight* (kg.)		*Stature* (cm.)		*Head Girth* (cm.)	
	N	Mean	N	Mean	N	Mean
Okinawans	56	2.80	56	49.2	56	33.4
U.S. Negroes[1]	14,034	3.20[2]	1,062	48.6[3]		
Mexicans[4]	210	3.17	181	50.1		
U.S. Japanese[5]	202	3.24	202	49.8	202	33.9
North Am. Whites[6]	108,715	3.40	10,663	50.3	4,967	34.2

[1]Data for weight collected in New York, Connecticut, Maryland, Ohio, and Georgia; data for stature in Maryland and Connecticut.

[2]Mean birthweight is known to exceed median birthweight by approximately 0.05 kg. (1). Consequently, this amount was added in the case of studies (11, 34) reporting medians but not means.

[3]The major study used here gave the median. It has been shown, however, that there is no systematic difference between mean stature and median stature (53).

[4]San Antonio, Texas, and Guanajuato, Mexico.

[5]Los Angeles, California.

[6]United States (New York, Maryland, Massachusetts, Pennsylvania, Ohio, Minnesota, Iowa, Georgia, California) and Canada (Ontario).

The exception is for Okinawans with American Japanese, and here the ratio ($t = 2.1$) is above the needed figure for confidence at the 5 per cent level.[2] Mean stature for the North American White infants will be seen to be greater than that for the Okinawa infants by 1.1 cm. (0.4 in.), or 2.2 per cent.

[1]Reference was made earlier to the discrepant figures for average stature of North American Negroes reported by Meyer (48.5 cm.) and Pasamanick (50.1 cm.). The composite mean of 48.6 cm. ($48.5 \times 1{,}027 + 50.1 \times 35/2$) is in harmony with the mean reported by Kelly and Reynolds (22) for Detroit Negro infants age 6 weeks—the Kelly-Reynolds mean is 51.6 cm., and it is known that increase in mean stature during the first six postnatal weeks approximates 3.0 cm. (see 30, p. 44). Further, the difference between the composite means of Table 1 for Negro and White newborns (1.7 cm.) is identical with the difference obtained by Kelly and Reynolds between the means for Detroit Negro ($N = 32$) and White ($N = 74$) infants age 6 weeks.

[2]The standard deviation for stature on the American Japanese subjects was 1.8 cm. No measure of variability was reported on the Okinawa subjects; since their stature was determined by "tape measure," a standard deviation of 2.4 cm. was assumed (see 30, p. 46).

3. Mean head circumference is smaller for Okinawa infants than for North American infants of Japanese or European descent. In the former comparison the difference in means is 0.5 cm., and in the latter it is 0.8 cm. (0.3 in.). Both these indications of sampling from unlike populations are statistically significant. That is, on the hypothesis of random selection of the subjects representing the different ethnic groups, the null hypothesis may be rejected in each instance at the 1 per cent confidence level.[3]

It cannot be assumed, of course, that the above findings reflect hereditary differences solely. There are tenable grounds for the position that the groups may differ systematically with respect to other variables. For example, it is probable that maternal diet during pregnancy is not equivalent from sample to sample.[4]

Early Childhood

At ages beyond birth, the Newman and Eng report is restricted to consideration of stature and weight. Correspondingly, the succeeding intercomparisons of the present paper are confined to these measurements.

Taking age 3 years as representative of early childhood, the attempt was made to compare Okinawans with North Americans of varying ancestry and socioeconomic status. It was found that for White children of low socioeconomic status, the only accessible recent[5] investigation at age 3 was on females. Since the Okinawa sample had been characterized as poor for diet and health care, use of this low-status-White study seemed desirable. Thus the decision that the materials assembled and presented in Table 2 should pertain to females exclusively.

The Okinawa values given in the first row of Table 2 were derived by a) applying the corrections Newman and Eng specify (37, p. 146) to the appropriate figures from their tables, and b) interpolating. Interpolation was also necessary in obtaining one of the two component means utilized in deriving the stature value of the second row—the mean typifying a sample of 11 Negro females measured in 1935 at the Riverdale Orphanage, New York (35, p. 202). The remaining data of the second row were collected on 11 Negro females in attendance 1941-42 at two WPA nursery schools in Des Moines, Iowa (44, p. 21). Presented in the third row are stature and weight means for 7 Mexican females examined in Mexico and Texas during 1941-42 (13, pp. 70-88).

The last three rows of Table 2 carry means on White females of northwest European ancestry representing different socioeconomic levels. For

[3]The standard deviation for head girth reported on the American Japanese was 1.2 cm. A standard deviation of 1.3 cm. was assumed for the Okinawa infants (see 31, p. 47).

[4]In this connection, see Burke, Harding and Stuart (7, p. 513).

[5]It is important in racial and socioeconomic comparisons to take cognizance of the secular period in which each series of data were collected. For findings on secular change at early childhood ages, see Meredith (29, pp. 18-19; 30, pp. 11-15).

the "lower classes" group, two-thirds of the fathers either were unemployed or employed as laborers: the records on this group were obtained 1939-41 at WPA preschools in the vicinity of Birmingham, Alabama (55, p. 168). The subjects which comprise the "middle classes" sample

TABLE 2

STATURE AND WEIGHT MEANS ON SIX GROUPS OF FEMALES AGE 3 YEARS

Data all collected between 1930 and 1945

Group	*Stature* (cm.) N	*Stature* (cm.) Mean	*Weight* (kg.) N	*Weight* (kg.) Mean
Okinawans[1]	55	86.1	55	11.3
U.S. Negroes	22	90.3[2]	11	14.5
Mexicans[3]	7	88.2	7	13.5
U.S. Whites:				
Lower classes[4]	20	92.4	20	14.3
Middle classes[5]	79	94.6	103	14.5
Upper classes[6]	34	95.7	34	14.7

[1]Diet and health care poor (see 37, pp. 146-148).

[2]Pooled here are two samples of 11 each drawn at an orphanage and at WPA nursery schools. The mean from the orphanage sample is strikingly low—86.6 cm. A mean of 90.6 cm. was secured by Woodbury (57) from 1918-19 data on 209 Negro females living primarily in southern and eastern states, and a mean of 90.9 cm. by Herskovits (17) from 1923-26 data on 28 Negro females residing primarily in New York (Harlem) and West Virginia.

[3]Mexico and Texas, socioeconomic status "generally low" (13, p. 13).

[4]Alabama WPA nursery schools, mean family income (1939) $670 annually.

[5]Massachusetts homes of "middle economic circumstances," enrolled from birth in a program which afforded parents "periodic health and nutritional advice" (53, p. 156).

[6]University of Iowa preschools, professional and managerial classes.

fall almost entirely into the semiskilled, skilled, commercial, and minor managerial occupational categories. All were enrolled from birth at the Center for Research in Child Health and Development, Boston, and were the recipients of periodic health examination and pediatric advice (53, pp. 163, 165). The sample for "upper classes" was drawn between 1938 and 1941 at the University of Iowa Preschool Laboratories, Iowa City; "one-third represented the managerial or commercial groups and two-thirds the professional classes" (55, pp. 169-170).

Findings with reference to Table 2 are:

1. Compared with 3-year-old White children of the United States, Okinawa children at age 3 are markedly shorter and lighter. The means in Table 2 from the "lower classes" sample of White females surpass the corresponding means on Okinawans by 6.3 cm. (2.5 in.) for stature and 3.0 kg. (6.5 lb.) for weight. Matching the Okinawa means from both males and females against the Vickers and Stuart (53) means on middle class, well-cared-for, White children, it is found that the Okinawa 3-year-olds are similar to the Boston 2-year-olds in stature and 1.5-year-olds in weight.

2. The obtained means at age 3 years are larger on the Mexican females than on the Okinawa females by 2.1 cm. for stature and 2.2 kg. for weight. Although these differences have appreciable magnitude, their statistical dependability is heavily handicapped due to the paucity of Mexican subjects. Recognizing this, and having access with both ethnic groups to male as well as female data, tests of significance were made for the two sexes jointly.[6] In the case of weight, a statistically significant difference was obtained at the 1 per cent confidence level. For stature, however, the difference was not reliable.

3. In relation to 3-year-old Negro children of the United States, Okinawa 3-year-olds are much smaller. The WPA nursery school means obtained by Sessoms (44) on Negro children of both sexes ($N = 20$) exceed the Newman and Eng means for both sexes by 6.9 cm. (2.7 in.) in stature and 2.8 kg. (6.2 lb.) in weight. Even the quarter-century-earlier sample of American Negroes studied by Woodbury (57)[7] surpasses the Newman and Eng sample by 4.7 cm. (1.9 in.) in mean stature and 1.6 kg. (3.5 lb.) in mean weight.

Late Childhood

At birth (Table 1) and in early childhood (Table 2), it has been possible to compare Okinawa children with North American children of White, Negro, Mexican and Japanese ancestry. In later childhood, materials are available on each of these groups and also on North American Chinese, Eskimos, and Indians.

Table 3, for stature, and Table 4, for weight, show the mean size of Okinawa children at ages 6 to 10 years in relation to the mean size of ten ethno-socioeconomic groups of North American children and one sample each of French and South African Bantu children. The means of both tables are for males and females together, and in all instances are derived

[6]The number of subjects was increased to 15 Mexicans and 132 Okinawans. For the Okinawans, standard deviations of 3.5 cm. and 1.6 kg. were assumed. For the Mexicans, the stature and weight records of each individual were available.

[7]The number of subjects was 367 at age 3 for both sexes combined.

TABLE 3

STATURE MEANS (cm.) AT FIVE AGES ON THIRTEEN GROUPS OF CHILDREN STUDIED BETWEEN 1930 AND 1945

Each mean represents children of both sexes.

Group	*Age in years:* 6	7	8	9	10
OKINAWANS: poor diet and health care (37)	102.0 (240)	106.6 (279)	113.0 (342)	118.2 (420)	122.6 (444)
MEXICANS: Texas & Mexico; low economic level (13)	107.1 (38)	112.5 (39)	117.7 (41)	122.6 (46)	128.2 (49)
SOUTH AFRICAN BANTU (Negro): "inadequate" diet (24)		114.0 (242)	119.0 (407)	123.2 (535)	127.1 (712)
FRENCH: Marseilles; all economic classes (48)[1]	107.8 (62)				128.8 (49)
U.S. PUEBLO INDIANS: barely subsistence level (40)[2]	109.3 (275)	114.0 (408)	118.7 (405)	123.7 (407)	129.2 (386)
U.S. CHINESE: Lower and middle classes (41, 56)[3]	109.3 (282)	114.3 (292)	119.3 (304)	124.3 (340)	129.0 (366)
U.S. JAPANESE: California; all vocations (25, 41, 50)	110.2 (269)	115.3 (374)	120.4 (516)	125.6 (576)	130.8 (504)
U.S. MEXICANS: Los Angeles public schools (25)	112.4 (1,877)	118.0 (2,180)	123.7 (2,253)	128.8 (2,250)	133.7 (2,253)
NORTH AM. WHITES: Poorest urban districts (19, 54)		118.6 (583)[4]	123.4 (661)	128.9 (717)	134.4 (678)
U.S. NAVAHO INDIANS: New Mexico and Arizona (46)	114.8 (140)	119.9 (200)	124.9 (236)	130.6 (276)	135.1 (339)
NORTH AM. WHITES: all socioeconomic groups.[5]	115.0 (20,817)	120.7 (26,292)	126.2 (28,732)	131.5 (30,738)	136.5 (31,738)
U.S. NEGROES: Los Angeles public schools (25)	115.1[6] (363)	121.5 (407)	127.0 (403)	132.8 (428)	137.2 (410)
NORTH AM. WHITES: business and professional classes.[7]	117.3 (849)	122.6 (1,518)[8]	128.2 (1,451)	133.6 (1,437)	139.3 (1,538)

[1]Sample "probably somewhat weighted on the side of low economic status" (48, p. 424).

[2]Data collected in New Mexico and Arizona.

[3]Mainly residents of "Chinatown," San Francisco.

[4]Number of subjects in Hopkins' study (19) apportioned as 400 at each age.

[5]Keyfitz (23), Lloyd-Jones (25), and O'Brien, Girshick and Hunt (38).

[6]Los Angeles' White children were found to be slightly taller at each age.

[7]Simmons (45) and Stuart and Meredith (49) at each age; "best districts" data from Weisman (54) and Hopkins (19) at ages 7 to 10.

[8]Number of subjects in Hopkins' study apportioned as 480 at each age.

TABLE 4

WEIGHT MEANS (kg.) AT FIVE AGES ON THIRTEEN GROUPS OF CHILDREN STUDIED BETWEEN 1930 AND 1945

Each mean represents children of both sexes.

Group	*Age in years:* 6	7	8	9	10
OKINAWANS: approximate weight unclothed (37)[1]	16.3 (240)	18.4 (279)	20.3 (342)	22.8 (421)	24.9 (445)
SOUTH AFRICAN BANTU: weight taken nude (24)		19.6 (242)	21.3 (408)	23.0 (536)	24.8 (713)
U.S. CHINESE: approximate weight unclothed (41, 56)[2]	17.9 (282)	19.5 (293)	21.4 (305)	23.4 (341)	25.7 (367)
U.S. PUEBLO INDIANS: allowance for clothing (40)	18.3 (275)	19.9 (408)	21.7 (405)	23.9 (407)	26.5 (386)
FRENCH: weight taken with children nude (48)	18.5 (62)				26.3 (50)
MEXICANS: allowance made for clothing worn (13)	19.0 (38)	20.5 (39)	22.5 (41)	24.6 (46)	27.8 (49)
U.S. JAPANESE: approximate nude weight (25, 41, 50)[3]	19.0 (269)	21.0 (374)	23.1 (516)	25.5 (576)	28.4 (504)
U.S. NAVAHO INDIANS: allowance for clothing (46)	19.6 (140)	21.4 (200)	23.5 (236)	25.8 (276)	28.3 (339)
NORTH AM. WHITES: low economic status (19, 54)[4]		21.4 (596)	23.7 (679)	26.2 (687)	29.1 (646)
U.S. MEXICANS: 1.0 kg. off means for clothing (25)	20.0 (1,877)	22.1 (2,180)	24.7 (2,253)	27.2 (2,250)	30.1 (2,253)
NORTH AM. WHITES: all socioeconomic groups[5]	20.5 (20,817)	22.8 (26,292)	25.3 (28,732)	28.0 (30,738)	31.0 (31,738)
U.S. NEGROES: means lowered 1.0 kg. for clothing (25)	20.5 (363)	23.1 (407)	25.5 (403)	28.6 (428)	31.3 (410)
NORTH AM. WHITES: business and professional classes[6]	21.4 (732)	23.4 (1,448)	26.2 (1,396)	29.3 (1,406)	32.8 (1,496)

[1]"Weighed fully clothed . . . clothing light"; 1.0 kg. deducted from each mean.

[2]Weighed in one layer of underwear (41) or "clothed below the waist . . . except for shoes" (56). Latter study adjusted by lowering each mean 0.5 kg.

[3]Weighed nude (50), in one layer of underwear (41), and with shoes, coats and heavy sweaters removed (25). Last means (25) were subjected to a 1.0 kg. reduction.

[4]Reductions of 0.5 kg. for clothing below waist (19) and 1.0 kg. for clothing minus shoes and sweaters (54). Medians (19) were adjusted to approximate means by adding 0.4 kg. at age 7, 0.7 kg. at 8, 1.0 kg. at 9, and 1.5 kg. at 10.

[5]One layer of underwear (38) or 1.0 kg. deduction for clothing (23, 25).

[6]Partly nude (29), partly 0.5 kg. reduction for clothing below waist (54), and partly 1.0 kg. reduction for clothing minus shoes and sweaters (19, 45).

from data collected within the secular period 1930 to 1945.[8] Each table is arranged with the smallest series of means appearing in the first row, the series of next higher magnitude in the second row, and so on in rank order to the largest series at the bottom of the table.

The materials used in compiling Tables 3 and 4 are conveniently discussed following the sequence of their presentation in Table 3. *Okinawa children:* In addition to combining for sex, it was necessary—as at age 3—to adjust the Newman and Eng means "for age, weight of clothing and thickness of sandals" (37, p. 146). *Mexican children:* These data were collected in 1941-42 on residents of Texas (mainly San Antonio) and Mexico (Celaya and Guanajuato in Guanajuato, Monterrey in Nuevo Leon, and Saltillo in Coahuila). Goldstein characterized the living conditions for the group as a whole as "generally poor" (13, p. 32). *South African Bantu children:* The subjects were Bantu-speaking Negro school children[9] in nine areas of the Union of South Africa, three urban and six rural. Their diet was described by Le Riche as "inadequate in amount and quality" (24, p. 25). *French children:* Stuart and Kuhlmann (48) gathered these data in 1941 at Marseilles, France. The sample was drawn partly by enlisting the cooperation of families considered representative of the city, and partly through "the schools."

Pueblo Indian children: These children, examined at Indian schools during the years 1931-34, "came from 16 pueblos in the Rio Grande valley of New Mexico and 9 Hopi villages of northwest Arizona" (40, p. 150). Their general economic level was appraised as "somewhat above subsistence" and their diet as "inadequate in both quantity and quality" (40, p. 17). *American Chinese children:* The means presented, for both stature and weight, are composite values on children of Cantonese ancestry measured in 1931 through "language and church schools" of San Francisco and Oakland (41), and in 1935 through "public, parochial and private schools" of San Francisco (56). Roughly half of the fathers were unskilled or semiskilled workmen, and half were engaged in small business, commercial, and skilled occupations. *American Japanese children:* Again, for stature and weight, composite means are given—means derived by pooling data from the investigations of Lloyd-Jones (25), Preston (41), and Suski (50). The records were amassed between 1930 and 1938, Preston's at language and church schools in San Francisco, and those of Suski and Lloyd-Jones at public and private schools in Los Angeles. All occupational groups are represented, "from unskilled laborers to business men, manufacturers, literary and professional people."

Mexican children: This sample of Mexican children was obtained in the schools of Los Angeles during the years 1936-38 (25). Compared with the

[8]On the magnitude of secular variation in children 6 to 10 years of age, see Keyfitz (23), Meredith (28, 29), Meredith and Meredith (33).

[9]Fingoes, Pondos, Sesuto, Xosas, and Zulus.

Mexican sample previously described, it probably a) represents greater heterogeneity from the standpoint of recent lineage and b) typifies a somewhat higher socioeconomic level. *North American White children of low socioeconomic status:* The data used in calculating these means were accumulated over the period 1932-45 on children attending seven schools in the "poorest districts" of Minneapolis, Minnesota (54), and Ottawa, Canada (19). *Navaho Indian children:* These means are based upon measurements collected between 1932 and 1934 at reservation schools in New Mexico and Arizona. "Care was taken to select those children who were relatively pure Navaho, *e.g.*, those who were known to have any White blood were rejected" (46, p. 115).

North American White children of all socioeconomic groups: Three large series of measurements on "the general run of White American-born boys and girls" were pooled. One series was amassed during 1936-38 in the elementary schools of Los Angeles (25), another during 1939 in the elementary schools of Toronto (23), and the third during 1937-39 "in public and private schools, on playgrounds, in camps, and in clubs" scattered over "16 States and the District of Columbia" (38, pp. 2-3). *American Negro children:* These data were obtained at Los Angeles schools as part of a 1936-38 "School Health Aid Project sponsored by the Los Angeles Board of Education" (25, p. 83). *North American White children of the professional and managerial classes:* For stature and weight, data were utilized from studies by Hopkins (19), Simmons (45) and Weisman (54). The stature materials were combined with data from Stuart and Meredith (49) and the weight materials with data from Meredith (29, p. 32). In the case of the studies by Hopkins and Weisman, the records were accumulated at seven schools in "better-class residential districts" of Ottawa and Minneapolis. The records of Simmons were on Cleveland children from homes "above-average both economically and educationally"; those of Meredith and of Stuart and Meredith on Iowa City children "predominately from the professional and managerial classes."

Given 120 stature and weight means arranged by table for measurement, by row for ethno-socioeconomic group, and by column for age, a large number in intercomparisons can be made. Stated differently, it is possible to extract from Tables 3 and 4 an extensive series of comparative findings. The following have been selected as illustrative:

1. Throughout late childhood, Okinawans are the shortest of the thirteen ethno-socioeconomic groups aligned in Table 3. Specific differences between the Okinawa means and the means for other groups range from 5.1 cm. to 15.3 cm. at 6 years of age, from 4.7 cm. to 15.2 cm. at 8 years of age, and from 4.5 cm. to 16.7 cm. at 10 years of age. The minimum and maximum differences are 4.4 cm. (1.7 in.) and 16.7 cm. (6.6 in.), the former separating the means at age 9 for Okinawans and Mexicans (Texas and Mexico data), and the latter the means at age 10 for Okinawans and North American Whites representing the professional and managerial

classes. Statistically, all of the stature differences from comparison of Okinawa children with children of the other groups are reliable.

2. In body weight, Okinawans are significantly lighter than any of the groups with which they are aligned over the age period 6 to 8 years and significantly lighter than nine of the groups at all ages from 6 to 10 years. Actual differences in the means for ages 6, 7 and 8 lie between 1.0 kg. (2.2 lb.) and 5.9 kg. (13.0 lb.)—the smaller figure holding for the age 8 means for Okinawans and South African Bantu, the larger figure for the age 8 means for Okinawans and North American Whites of the business and professional groups. At ages 9 and 10, the differences between Okinawans and South African Bantu lack statistical significance; the differences between Okinawans and American Chinese, also between Okinawans and French, are of doubtful significance; while in the remaining eighteen instances where statistical dependability is tenable, the means differ by amounts varying from 1.1 kg. (2.5 lb.) to 7.9 kg. (17.5 lb.).

3. Okinawa children 6 to 10 years of age are much smaller in body size than North American White children.[10] Compared with White children sampled without reference to socioeconomic status, they are shorter by an average of 13.5 cm. (5.3 in.) and lighter by an average of 5.0 kg. (11.0 lb.).[11] Taking account of separate segments of the North American socioeconomic continuum, Okinawans are smaller than White children of the laboring classes by 11.2 cm. (4.4 in.) for stature and 3.5 kg. (7.7 lb.) for weight, while they are smaller than White children of the professional classes by 15.7 cm. (6.2 in.) and 6.1 kg. (13.4 lb.) for stature and weight respectively.

At age 10, North American White children of the laboring classes are more than 9 per cent taller and over 16 per cent heavier than Okinawa children. Corresponding percentages, substituting North American Whites of all socioeconomic groups, are 11 and 24 respectively. Matched against the age 10 stature and weight means for Okinawans, North American White children of the professional classes are equally as tall by age 7 years and as heavy by age 7.5 years.

4. In relation to United States Navaho and Pueblo Indian children, the children of Okinawa are markedly smaller than the former and appreciably smaller than the latter. This is clearly shown by the average differences

[10]Attention is called to the fact that the ancestry of North American White children is predominately North European. This weighting carries implications for body size, *e.g.*, there are known differences in stature between North American White children whose ancestors came from northern and southern Europe. Samples of 400 boys of "North European" descent and 300 boys of "Italian" descent (9)—the two samples being matched for time (1922-28), place (vicinity of Boston), socioeconomic status (70 per cent of fathers semiskilled, 30 per cent unskilled), and age subgrouping (7, 8, 9 & 10 years)—showed the former to be taller than the latter by 3.5 cm. (1.4 in.). See also references 26 and 27.

[11]Each of these average values is the mean of the differences between the two groups at successive annual ages from 6 to 10, inclusive.

for the age period 6 to 10 years: Pueblo children exceed Okinawa children in stature by 6.5 cm. (2.6 in.) and weight by 1.5 kg. (3.3 lb.), while Navaho children exceed Okinawa children by 12.6 cm. (5.0 in.) in stature and 3.2 kg. (7.0 lb.) in weight.

At age 10, Okinawa children are shorter than Pueblo and Navaho children by 5 per cent and 9 per cent respectively; they are lighter than Pueblo and Navaho children by 6 per cent and 12 per cent respectively. Matched against 10-year-old Okinawans, Navaho children are as tall at 7.5 years and as heavy shortly after 8.5 years; Pueblo children are as tall prior to 9 years and as heavy by 9.5 years.

5. The overall body size of children of Mexican ancestry is greater than that of Okinawa children. In the case of children of Mexican ancestry living in Mexico and Texas, there is an average difference over the years 6 to 10 of 5.1 cm. (2.0 in.) for stature and 2.3 kg. (5.1 lb.) for weight. Parallel values contrasting Okinawa children with "Mexican" children residing in California are 10.7 cm. (4.2 in.) and 4.3 kg. (9.4 lb.). It will be seen that there are large differences between the two Mexican samples, 5.6 cm. (2.2 in.) in stature and 2.0 kg. (4.3 lb.) in weight.

Okinawa children age 10 are more than 4 per cent shorter and approximately 10 per cent lighter than 10-year-old Mexican children of Texas and Mexico; they are matched by these children in stature at age 9 years and in weight shortly after 9 years. Correspondingly, 10-year-old Okinawans are over 8 per cent shorter and about 17 per cent lighter than like age Mexicans of California; they are matched by this group for stature before 8 years and for weight soon after 8 years.

6. During the age interval 6 to 10 years, Okinawa children are shorter than United States children of Mongoloid stocks (*i.e.*, American Chinese and Japanese) and lighter than United States children of Japanese lineage. The average stature and weight differences between Okinawans and American Japanese are 8.0 cm. (3.1 in.) and 2.9 kg. (6.3 lb.), while the average stature difference between Okinawans and American Chinese is 6.8 cm. (2.7 in.). Weight means on American Chinese children exceed those on Okinawa children by 1.6 kg. at 6 years, 1.1 kg. at 7 and 8 years, 0.6 kg. at 9 years, and 0.8 kg. at 10 years. A gradual convergence of the two weight trends is indicated: this was suggested earlier when statistical estimates showed that weight differences between the two groups were significant at ages 6 to 8, but of doubtful significance at ages 9 and 10.[12]

7. Compared with Okinawa children, South African Bantu children are significantly heavier at 7 and 8 years of age and significantly taller at all

[12]While discussing North American children of Mongoloid lineage, it is pertinent to cite a report by Hrdlicka (20) for Eskimo children of the Kuskokwin region, Alaska, measured in the period 1928-31. Over the age interval 6 to 10 years, means on these children (N = 97) surpass those from Tables 3 and 4 on Okinawa children by 8.0 cm. (3.1 in.) in stature and 3.5 kg. (7.7 lb.) in weight.

ages from 7 to 10 inclusive. In both measurements, the two groups tend to become more alike with age. Differences between the stature means decrease from 7.4 cm. (2.9 in.) at 7 years to 4.5 cm. (1.8 in.) at 10 years. The weight means differ by 1.2 kg. and 1.0 kg. at 7 and 8 years respectively, and are practically identical at ages 9 and 10 years.

As indicated earlier, the comparative findings itemized in the text of this paper are no more than illustrations of the many accessible to the reader in Tables 1 to 4. It is anticipated that these tables will constitute a frequently used factual source on racial differences at birth and during the childhood years.

Summary

This paper pertains to the body size of children in the first decade of postnatal life. It brings together central tendency materials from studies on Okinawans; South African Bantu-speaking Negroes; North American Negroes; American Chinese and Japanese residents of California; Alaskan Eskimos; Mexicans living in California, Texas and Mexico; Navaho and Pueblo Indians of New Mexico and Arizona; European Whites living in Marseilles, France; and North American Whites of the upper, middle, and lower socioeconomic groups.

Analyses are made at birth, at 3 years of age, and at consecutive annual ages from 6 years to 10 years. The aspects of body size dealt with are stature and weight throughout, and head circumference at birth only. Methodology encompasses adjusting for differences in anthropometric technique, interpolating to attain age comparability, calculating composite means from multiple samples, and testing group dissimilarities for statistical significance. Comparative findings are drawn with particular reference to Okinawa children in relation to children of the other ethno-socioeconomic groups.

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A STUDY OF THE USES OF TOYS IN A HOSPITAL

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This is the report of a study of the use of toys which was carried on at the New York Infirmary, 321 East 15th Street, New York City.[1]

REASON FOR THE STUDY

The purpose of the study was to discover what uses toys can serve in a hospital and to gather information and suggestions through observation of their use which might be significant in the further design and manufacture of them. It was thought that such information would have significance for educators, parents, and others interested in children as well as for doctors and nurses and for the toy manufacturers.

By virtue of the fact that this study covers an area that has had limited exploration, this paper will deviate here and there from the conventional report of research. By reason of the exploratory character of the study, the differences between methods, on the one hand, and findings, on the other, are not always sharply defined, since methods had to be adapted and improvised as findings emerged.

A preliminary inquiry revealed a variety of practices relative to the provision of toys for hospital use. In some hospitals, most of the toys available to the children are those which they themselves bring from home and those which friends and relatives bring in. Such toys are largely used by the child to whom they belong except when he may wish to share them with another child. In some hospitals, volunteers collect and bring in toys and the ones thus provided are for general use. They are often given by local merchants, or contributed by interested organizations or individuals. This is apt to be a diversified collection. A few hospitals set aside funds for the purchase of carefully selected toys. A few provide a more or less well equipped playroom for ambulatory patients. A few have set up a nursery school or play group usually in the out-patient department.

In this study it was proposed to bring into the hospital toys selected with a view to the hospital needs, to observe their use as an integral part of the

[1]This study was conducted under the auspices of the American Toy Institute, the Research Division of the Toy Manufacturers of U.S.A. at the suggestion and with the counsel of the Institute's Advisory Committee, consisting of Mr. Lawrence K. Frank, Dr. Arthur T. Jersild, and Mrs. Eloise Parker. Opportunity to work in the New York Infirmary was made possible by Dr. Ruth Bakwin, Director of Pediatrics. Mrs. Eloise Parker, Occupational Therapist, at the direction of Dr. Bakwin made the practical arrangements for the observers while they were at the Infirmary. A number of the persons who participated as observers were students associated with Dr. Arthur T. Jersild at Teachers College, Columbia University. Dr. Jersild also advised in connection with the reporting of the study.

day's activities, and to evaluate their usefulness from the standpoint of what they contributed to the comfort, well-being, routine care and cure of the patients. This was found to vary somewhat from the usual approach.

It seemed reasonably certain that toys would be welcomed and used by the children in a hospital, as elsewhere, since play is a natural activity of children of all ages and toys are the tools of play. Under normal conditions a child tries out his developing abilities by means of toys; through their use he expresses his feelings and his growing understandings; with them he not only carries out ideas he already has but he also develops new ideas. In the process he gets a great amount of enjoyment and fun. In the case of a hospitalized child it is likely that toys not only have these same values but that they may have them to an even greater extent than under normal conditions, bringing besides reassurance and comfort as tokens of affection and good will.

To what extent toys might also help in connection with hospital routine and aid the work of doctors and nurses in accomplishing the purpose of the child's hospitalization was an open question. It was, however, surmised that they might be useful in this connection since the children going into a hospital take with them their everyday interests, desires, and needs, even though a new situation is created by the hospitalization. It was thought that the toys might also help in meeting the new needs thus created.

Time Covered

The study covered a period of approximately four and a half months. During the two and a half months preceding, a preliminary exploratory study had been carried on and observations made during that period are also included in this report.

Conditions for the Study

The study was carried on under the conditions of the regular hospital routine. It was recognized, at the beginning, that no special conditions should be set up for the study. Observations could not be allowed to interfere with, nor to hinder the work of, the doctors and nurses, for the children were there for care and treatment, and it was understood that this was the matter of first importance.

Further, it was recognized that the already heavy duties of the nurses must not be added to. It was understood that the nurses could not be called upon to give any special attention to the study itself since their duties were entirely toward the children. However, since some instruction on the value of toys is commonly included in nurses' training, it was to be expected that they would use the toys in their care of the children, and it was recognized that this would be a valuable source for observations.

As would be expected there were already some toys in the hospital with provisions for their storage when not in use. The addition of a considerable

number of toys for the study meant increasing this storage space, which was done even though the hospital was crowded and space at a premium. There was some play space in the center of the ward, since beds were placed with the heads to the wall. In this space there was a small table and low chairs where children could sit to play leaving some floor space where push-pull toys could be used. A bed stand at the head of each bed offered a place where a child in bed could lay small toys. The hospital was not equipped with bed tables, but trays were available on which a child in bed could play with his toys. These arrangements would be duplicated in a large majority of hospitals, and the findings are accordingly of more significance than if conditions had been more unusual.

The Hospital Set-Up

The New York Infirmary, one of the oldest hospitals in New York City, the main building having been erected in 1857, is unique in always having been entirely staffed by women and operated largely for women and children patients. It has a pediatric ward and children's clinics. Arrangements were made for observations to be made in both the Pediatric ward and in the Child Guidance and Allergy Clinics.

The Pediatric ward includes one general ward with 13 beds, one observation and isolation ward with 13 beds and outdoor roof space which is used when weather permits.

The Infirmary cares for practically all types of cases of children up to 13 years in the space above described. The children, during the period of the study, ranged from three months through 13 years.

The Child Guidance and Allergy Clinics in which observations were made are situated on the first floor. The children in the clinics range in age from 2 years to 13 years. The children coming to the clinics are accompanied by a parent or other adult. The children usually wait at one side of the waiting room to see the doctor, the parents waiting for them on the other side of the room. The room is equipped with benches and the children could play with the toys on these, or could use the aisles or the space in the front of the room between the front benches and the offices for push-pull types of toys.

The Children and Their Circumstances

As would be expected, the children who were in the hospital while the study was in progress presented a variety of conditions, including children waiting for or recovering from tonsillectomies or other operations; children with ear, nose, or throat difficulties; rheumatic fever patients; cardiac cases; children with pneumonia; children with arthritic conditions; children with cerebral palsy; children under observation awaiting diagnosis; children in casts for one condition or another, etc.

Children waiting for tonsillectomy or other operations sometimes appear anxious, perhaps awed by the strangeness of the place; sometimes they seemed disturbed by the necessary preliminaries for the operations; again they were apparently much interested in them. Children with ear, nose, throat or other acute difficulty appeared to be very uncomfortable for a short time and then progressively and quickly seemed to feel more and more comfortable with corresponding increase in interest in activities around them. Children in casts, naturally, varied greatly in the range of their activity depending upon the extent of their immobilization and the nature of their difficulty. There was, of course, great variation in the activity of all of the children. For some, it was necessary that they lie down most of the time. Of these, some might be too sick to be interested in play. Others might feel like playing a little. Some were able to sit up in bed to play. Some were in wheel chairs and thus were able to move from place to place and often did this to find companionship in play. Others were ambulatory and so able to move around freely.

As would be the case in any hospital, there were periods which inevitably were hard for the children. There were the periods of admission when everything was strange and for some children probably frightening even though everything possible was done to make it easy for them. There were the periods following the departure of parents either upon admission or after regular visits which, for some children, were sure to be lonely. There were the periods before an operation which must have been anxious times for some. And there were the periods of idleness and consequent boredom which could harly fail to come during long hospitalization.

Extent of Observations

During the four and a half months covered by the study there were 153 different children observed in the pediatric ward and clinics. Of these 126 were in the ward and 27 in the clinic. With a total of 26 beds this indicates a high turnover.

From the standpoint of the study this means that many times when the observer appeared there would be only a few children present who had been there at the previous observation. Often a given child would be seen by the observer only once. This meant that the observer saw the toys used by many different children.

The observations, therefore, could not follow a given child's use of the toy on consecutive days over a period of time, but of necessity rather centered on the toys themselves and on the various uses made of each one during each observation period with recording of the use of the toy, the ages of the different children using it, the degree of mobility of each child, any apparent physical condition explaining the use made of the toy, the part played by the adult, etc.

A few children were present continuously for a period of weeks and this gave the only opportunity to study the progressive use of toys by the same

child. These included an infant of seven months who had one leg in a cast when the study began and who stayed three and a half months; another infant of three months at the beginning of the study, under observation; four children with cerebral palsy, ages six, three and one half, and three years (2); and a girl of fourteen years with rheumatic fever.

As would be expected, the hospital records of the children were not available to the student observer, so they could record only such facts about the child as were told to them or as were plainly obvious to them. The head nurse always gave the observer such precautionary information as was needed to protect the child. Later in the study, as the nurses and observers became acquainted, many bits of information were given which were of great help in interpreting observations. Often the Occupational Therapist supplied some information. The name plate hanging on each child's bed gave the name of the child, the age, and the date of entrance.

Of the 27 different children observed in the clinics, some came only a few times, others regularly over a period of weeks. Here, too, there was opportunity to learn little more about a child than could be seen by a casual observer.

Helpful Attitudes of Doctors and Nurses

The interest and encouragement of the doctors, the director of the clinics, and the nurses, and their willingness to allow the observers as much freedom as possible was of the greatest help. Doctors often stopped to play with a child for a few moments and were very generous in the time they, themselves, gave in observing the children's use of toys and in passing on their comments. The Director of the Dispensary and Assistant Director of Nursing Service made observations in the Clinic and on her own time wrote up her comments on the use of the toys. The Head Pediatric Nurse was a keen observer, kept notes of her observations, and wrote a summary report at the end of the study. These observations and comments by members of the Staff were of the greatest help in the study, being made as they were, by those most familiar with the situation.

Necessity of Gearing Observations to Hospital Routine

As time passed, the student observers gained increasing understanding of the hospital routines and regulations and this made it progressively possible for them to make their observations without causing difficulties for doctors and nurses. This understanding by observers is of the utmost importance in making a hospital study and upon it often hinges the effectiveness of the study. For example, the observers must remember, respect and be ready to carry out the hospital requirements, such as always wearing a washable smock. They must know and respect the fact that when doctors are making their rounds in the ward full attention must be given to that and an observer must keep out of the way and record silently and unobtrusively.

The observer must also know and respect the fact that given things happen at given times in the ward—such as baths, feedings, naps, etc., and that these times must be respected. There is likely to be no opportunity for the observer to question, only to observe and record. These details are of great importance in making a study of the use of toys in a hospital, for their use must be fitted to the hospital routine and not the routine to the toys.

In the present study, no request was made for anything in the hospital routine to be changed, since one purpose of the study was to discover whether or not toys have a usefulness in carrying out that routine and if so, what.

Selection of Toys for the Study

The initial selection of toys to be used in the study was made on the basis of what is commonly known about the interests of children of different ages in general, and the interests of ill and convalescent children in particular.

At first, toys were selected from each of the following major groups—manipulative toys, construction toys, toys for active play (push-pull type), toys for imaginative play, games, and puzzles. It was thought best to begin with a few toys of several different types rather than with many in order to give variety and at the same time avoid confusion and for the very practical reason that space was not available at first for storing many.

Care was taken to include in the initial selection, toys which it was thought would be of interest to the different age groups, bearing in mind the fact that ill and convalescent children probably would prefer things that could be handled more easily than those with which they would ordinarily play. Toys calling for strenuous physical effort were avoided and for the most part the items selected were toys with which a child could play alone. Since it was known that play on the floor was not looked upon favorably in this hospital this was kept in mind and blocks and similar materials usually used by children on the floor were not at first included. Crayons, paints, clay, were at first omitted since bed tables were not available and it was hard for the children to use these materials without. Since space was limited large toys were not included. It was kept in mind that all toys for hospital use must be such as could be sterilized, carbolized, or otherwise kept sanitary, since many different children with many different ailments would be using them. Further, noise-making toys had to be avoided since quiet on the ward was necessary and in the clinic noise and confusion had to be avoided. A considerable variety of toys was provided and this made it possible to get an indication of the types of toys most popular with the children, most useful from the standpoint of doctors and nurses, and most suitable for a hospital set-up.[2]

[2]A study which deals more particularly with the suitability of toys of various size, structure, and architecture for hospitalized patients is being prepared by Miss Claudia Gips.

A second selection of toys was made a few weeks after the beginning of the study. This selection filled in some of the gaps obvious in the first selection and included dolls, much more equipment for housekeeping play, paints and clay, more games, and some additional manipulative toys, since so many of the children were under four years and also since manipulative toys are of special usefulness for cerebral palsy cases.

A further addition which was made just before this report was written brought in more puzzles and games, more construction toys, more dolls, coloring books, picture books, miniature toys and dolls and doll furniture, sewing sets, weaving mats, etc. Most of these toys had just arrived when this report was being written so observations of their use and comments on them will be left for a later report.

Since from the beginning the children showed great interest in housekeeping equipment it was apparent that much use would be made of this if a play corner could be set off by itself where such equipment could be used by ambulatory patients and while this report was being written this has been done. In continuing the study, it will be of interest to add different types of toys for housekeeping play in order to discover what purposes each will serve and which best fit the hospital needs.

Presentation of the Toys

Sometimes the toys were brought into the ward by the Occupational Therapist, sometimes they were offered by the nurses, and sometimes by the observers as they became accustomed to the hospital routine.

In distributing toys to the children, the Occupational Therapist always kept in mind the child's diagnosis and any special orders left by the doctor; the child's strength and span of endurance; his general ability, physically and mentally, and his age and particular interest.

There was no prescribed way of offering a toy. Neither was there any set rotation of toys nor any time limit on their use. Sometimes a toy which the observer thought would interest a child was taken to him, only to have him turn away from it. Perhaps another one offered would be seized upon at once. Sometimes two or three toys would be taken to a bed and a choice offered. As children grew familiar with the toys, one or another would often ask for some favorite one. Sometimes several toys would be placed on the play table in the center of the room, or on the table on the roof if the children were there, and ambulatory children could make their own choices. Sometimes a child would be left to play with the toy alone, again the adult might play with him for a time. This might be the doctor, or the Occupational Therapist, or the nurse, or the observer, or one of the volunteers who were present from time to time.

At first the toys when not in use were kept in a cupboard just outside the ward. Later, in order that they might be more easily available to the children, a toy chest on the ward was provided where the children could get them as they wanted them.

Nature of the Records

The observers took notes on the use made of each toy, the age of the child using it, whether he was in bed or out, any information about his condition that was available, the child's comments, if any, about the toy, whether he played alone or with others, etc., adding such interpretative comments as the observer thought might later be useful in understanding the play. There was no set form for taking notes.

There was some attempt at first to keep a record of the length of time a toy was used by a given child but this was not very successful. Often it still would be in use when the observer left, or it might be used a little while, laid down, taken up by another child, laid down and again taken up by the first child. At any rate, the length of time a toy was used seemed not nearly so significant as what was done with it.

Since the students making the study could be at the hospital for only limited periods of time, the Occupational Therapist kept notes of her observations; the Head Nurse, as mentioned before, did likewise; and all of these observations together with comments of doctors and others and observations of the writer have been taken into account in this report of the findings. With the experience gained through this study, later studies may well be made with more uniformity and with a more systematic series of observations.

Findings

The findings of the study are varied and suggestive. They cannot, however, as will be observed from the above account, be set forth in definitive quantitative tables. It has not been possible to draw up frequency tables to show the incidence of this or that use of a toy, nor has it been possible to chart the time a given toy was used. Rather, the findings have had to be set forth in a series of summary statements showing the uses of the toys as noted by all or most of the observers. These statements, because of the rapid turnover of the children mentioned earlier, represent observations of many different children, of varying ages and with many different types of ailments. The only exceptions are the observations of children with cerebral palsy where the statements made are based on observation of four children each with a different type of difficulty, and the observations of three other children present for three and a half months at the longest.

Findings Related to Use of Toys in the Hospital

Aid in Tiding Over Critical Periods

The observations showed that frequently a toy seemed to be useful in tiding over some critical moment. Again and again it was noted by observers that the crying which often occurred as the parent departed after admission tended to diminish when some interesting toy was offered. Even though the toy might be refused at the moment and the crying continue,

usually it was not long before attention turned to the toy and when that happened the crying tended to die away very shortly. The same thing often happened when parents left after their regular visits. Again and again the records showed toys being given to children to while away the period of waiting before an operation. Presumably, in play with the toys, some of the anxiety concerning the operation, if there were such anxiety, was lessened. Frequently, it was noted, a toy was offered coincident with the approach of the doctor for dressing and, in the opinion of the observers, may have helped in lessening any resistance there might have been to the necessity of the moment.

Even the cherished toys which children bring with them from home, the observer pointed out, do not seem to serve the same purpose as the toys they meet at the hospital—new to them perhaps—and compelling enough in their novelty to help them forget the troubles of the moment.

Aid to Routine

The observations further showed that toys were frequently used in connection with carrying out some necessary routine, and in the opinion of the observers, seemed to be of some assistance. Often, at nap time a child would ask for some favorite toy and would play quietly with it until sleep came, perhaps still holding it while sleeping. Sometimes, a child who, instead of resting, wanted to visit with the child next to him at nap time would be given a toy and would turn attention to it, soon getting quiet enough to drop off to sleep. The records show one child who often wanted the doll to have a bath when she had hers and who seemed greatly delighted when the nurse entered into the fun with her. Conceivably this might be an aid in getting a child's cooperation in this necessary routine. There were other children who wanted the doll with which they had been playing to sit beside them as they ate, and who were very pleased at the nurses' willingness for the meal to be shared. In the opinion of the observers this might be an aid with children who, for one reason or another, were not particularly interested in meal time.

Relief from Boredom

The records show numberless instances where toys served to turn what might have been periods of boredom into periods of happy activity. For example, Sharon was a seven-months-old baby with one leg in a cast to her hip. The nurses played with her but often there were times when they had to be busy with other things. One day, as a nurse who had been playing with her left her to attend to other duties, Sharon began sucking her thumb. The nurse brought a toy with dangling balls and rings suspended from a heavy tape which fastened across the crib and put it on the crib just in front of Sharon. She watched as it was being fastened and as the nurse stepped back, Sharon reached out with her free hand and touched one of the rings. Evidently pleased with the feel of it, out came the thumb,

and both hands were used as she touched rings and balls, often trying to get one into her mouth. For forty-five minutes she played using both hands and stopped only when lunch time arrived. During the remaining six weeks of her stay this toy remained of absorbing interest. As she began to sit up she often pulled herself up by it and as she sat more and more steadily she played with it, sometimes pulling on the balls and rings, again swinging them back and forth, often putting her hands through the rings. Other toys were added from time to time and Sharon's days were busy, happy ones, as she played first with one and then with another. Presumably the interest in the toys lessened the thumb sucking with which she might have occupied herself.

An eleven-month-old baby in the play pen on the roof cooed and gurgled, and gurgled and chuckled as he played for more than thirty minutes with some small rubber blocks. He felt them, he chewed on them, he hit them together as he held one in each hand, and then, too sleepy to play longer, he toppled over sound asleep still clutching a block in each hand. There he slept with the blocks all around him and one, evidently bouncing when he hit it as he toppled over, lying in the middle of his back.

Effect on Morale

The contribution of high morale to accomplishing the purpose of hospitalization is well known, and is often pointed out as being particularly important with children under long hospitalization or those for whom being away from home is difficult. Toys are often mentioned as being useful in maintaining children's morale under any kind of trying or unusual or difficult condition and the observations showed many instances where they seemed to serve this purpose in the hospital.

One such instance is of a 14-year-old rheumatic fever patient who had been hospitalized for a period of several months. She became progressively more interested in first one kind of material and then another, began to show interest in the younger children's use of toys, and gradually came to welcome, and then to ask for a game or puzzle or piece of weaving or sewing material.

Substitute for Mischief

The records contain frequent mention of the use of toys in reducing or preventing the problem of discipline which can be disrupting on a hospital ward or in a clinic. Both the Head Nurse and the Director of the Clinic made special mention of this. Records show instances when the offer of a toy brought an impending quarrel to an end. Children busy with toys in which they were interested had something better to do than chasing each other around the ward. Being busy with a toy helped to reduce the aimless yelling at each other from one bed to another, or if yelling did begin, the offer of toy telephone, for example, turned attention to more constructive play.

Revealment and Expression of Feelings

The revealment and expression of the child's inner thought and feelings through the play which was observed especially in the clinic was mentioned often by the observers. It should be understood that in commenting on what they recorded of the play observed, the observers were making their own interpretations which, under the cicumstances, were of necessity largely speculative. They had no way of knowing the background of the children observed, nor did they have any information about the reason for the child's being brought to the clinic. Of course, no one but the clinic workers talked with the parents, and observers could not expect information thus secured to be passed on to them. Therefore, they observed the children and parents as they came, observed and recorded the children's use of the toys, and made such comments as occurred to them, concerning the possible significance of the play which they observed. Being familiar with children and their play and knowing that a child's inner thoughts and feelings are often clearly revealed in his play wherever he may be, it was entirely natural and to be expected that the observers would feel that, in the hospital too, the play was similarly revealing.

The records show that the play with miniature-life toys, house furnishings and dolls, was greatly varied and, in the opinion of the observers, significantly revealing. Sometimes a child would spend considerable time arranging and rearranging the pieces of furniture commenting as he did so. Again, scenes of violent family friction were played out in realistic detail. In one case, the family went on an outing and two of the children were lost with ensuing excitement. Another time, there was a fire and all the furniture had to be taken out of the house with much comment alternated with the subdued screeching of fire sirens. In one instance, the mother in the family was made to put all of the other members outside with the door closed behind them. Scenes of eviction were played out frequently.

The records show that the toy telephone brought forth many different kinds of conversations. Sometimes a child called up his mother and asked her to hurry and come for him. Again, one called a friend and carried on a long conversation telling all sorts of family doings and bits of news. Again, one called a member of the family and gave a minute account of all that he (the child) had been doing for several days. Another called someone and told in no uncertain terms what he thought of him. One called a child a few feet away also playing with a toy telephone and when this child said "Hello" the one calling shouted "Shut up" and slammed down the receiver.

The observers, in their comments, mentioned the usefulness which they saw in having toys available during the necessary waiting periods at a clinic, since the play for which they would offer the opportunity could be expected to furnish significant clues to the child's thinking and feeling about the difficulty which may have been the cause of his being brought

to the clinic. The records mention, also, that waiting mothers seemed to be interested in the play not only of their own child but of other children. One mother was heard to comment to another mother that she did not know her child could do so well as he put some puzzles together quickly and skillfully. Another seemed to get great amusement from hearing her little girl talking over the toy telephone and was heard to say to another mother a few seats away "Sounds just like me when I scold the kids." In commenting on these observations in connection with the children's play, the observers mentioned the possible usefulness of the toys and the consequent play in revealing to the parents themselves some of their children's feelings and thoughts. No doubt toys are used in this way by the workers in their conferences with children and parents, though the observers had no way of knowing and saw only the play in the waiting room which served the main purpose of keeping the children occupied.

Use of Toys by Cerebral Palsy Cases

The usefulness of toys in meeting the special needs of cerebral palsy cases was frequently mentioned. The toy telephone, for example, encouraged conversation of a kind useful for the child with speech difficulty. The manipulative toys, such as one which permitted colored wooden disks to be slipped over a metal loop fastened into a firm base offered exercises for hand muscles of a sort that seemed to be needed by the child whose hands do not function normally. Toys that could be used on the table as a child stood beside it helped to keep on his feet the child whose leg muscles were unsteady. From the observations it was obvious that only the very barest beginning has been made in discovering the usefulness of toys as an aid to treatment of cerebral palsy cases.

Good Fun

The fun and happiness which children in the hospital, as elsewhere get out of toys is one of their most observable values and was mentioned again and again by the observers. The records cite many instances of children playing with apparent enjoyment for long periods of time. Frequent instances are recounted of nurses joining in with the child's play to the child's evident satisfaction. Obviously this was considered important by the hospital as indicated by the willingness to have their supply of toys supplemented with those brought in for the study and the willingness to have the study carried on.

Findings Relative to the Selection of Toys for Hospital Use

Cleaning

Included in the observers' records was frequent mention of seeing the nurses cleaning the toys either by sterilizing, rubbing with alcohol, scrubbing, or airing in the sun. This brought to the observers' attention the fact

that the toys selected for hospital use must be such as lend themselves easily to such cleaning, and further that they should be able to withstand the often-repeated cleanings necessitated by the fact that they are used by many different children with many different ailments.

Durability

During their period of observation the observers evidently became increasingly aware, as evidenced in its frequent mention in their notes, that toys for hospital use need to be sturdy and durable since they are in use a great deal of the time and are used by many different children of different ages.

Packaging

Mention was made of the need for sturdy durability of the boxes in which toys were packaged. Children playing with a toy in bed, particularly, records showed, used the box in which it came, sometimes as a surface on which to play, sometimes as part of the play itself. The greater the durability of the box, too, the easier the care of the toy when not in use. Boxes in which toys can be easily repacked were mentioned as desirable not only to provide care for the toy, but to encourage the child's putting the toy away.

Ease of Use

The observers frequently mentioned that the children seemed to want quick results in their play and that the toys which seemed to catch and hold their interest were those that were easy to use, with minimum of small pieces to get lost. Generally speaking, they seemed to want toys a little simpler than their age would have indicated. This is easily understandable, since they were below par physically and so welcomed toys that called for less than their usual effort. This suggests selecting toys that are easy to use and ones with which quick results are possible.

Individual Play

Observations indicate that a relatively large amount of the play observed was individual, since much of it took place in bed. Even when children were ambulatory the play might still be largely individual, perhaps because less effort was required, perhaps because the children were not well enough acquainted to join in play together, perhaps because the age of the child made him unready for play with others. In any case, this suggests selecting, for the most part, toys with which a child can play alone with a few included which two or three might use together. Some of the toys which could be used by a child playing alone were also used equally well by two or three, for example, dolls, housekeeping toys, puzzles.

Interest Appeal

Just what made for interest appeal was, perhaps, a matter of opinion and speculation and a point requiring more study. In some instances, observers

thought it was color and sound, particularly with the younger children. In others they mentioned the novelty and unfamiliarity of the toy to the child, but again it was the familiar which seemed to make a toy welcomed. Sometimes, obviously, it was because the toy satisfied the child's interest in manipulation, again it was because the toy lent itself to creative use, to carrying out the child's own idea. Or it might be because of its possible use for dramatic play. Sometimes it seemed to be the idea for play suggested by the nature of the toy that made it welcomed. For example, the container with six milk bottles usually started a milkman on a route from bed to bed forthwith. The drinking-wetting doll immediately suggested play with her as a baby. Tea party dishes suggested setting the table followed with tea party play. Toys with such obviously suggestive possibilities were usually accepted readily. Some others, less obviously suggestive might take a period of play with the adult before interest took hold.

Instructions for Use

The observers often mentioned that when instructions accompanied the toy, the children were very pleased when they could read and follow them with a minimum of adult help. This suggests the desirability of simple, clear, easy-to-follow instructions. Further, mention was made that having instructions on the box lid instead of on a separate paper, was an aid to nurses, reducing the danger of their being lost or destroyed.

General Conclusions

Examinations of the records of the observations show that, in the opinion of the observers, the study, though admittedly limited, indicates convincingly:

1. That toys serve such a useful purpose in a pediatric ward and in children's clinics that there is good reason for them to be considered a part of a hospital's standard equipment.

2. That toys are a valuable if not indispensable aid in accomplishing the purpose of the child's hospitalization and of his attendance at the clinic.

3. That toys are of practical use in aiding the nurse in getting her work done, since they help to keep the children happily occupied, reduce the problems of discipline, and make it easier for her to carry out the doctor's orders for keeping certain children in bed, others quiet, etc.

4. That toys have a practical usefulness in meeting the needs of special cases such as children with cerebral palsy, poliomyelitis, rheumatic fever, etc.

5. That toys serve a constructive purpose in the clinic waiting room, through providing the opportunity for interesting activity, thus reducing aimless running around and giving children something more interesting

to do than indulging in loud, boisterous play or quarreling among themselves.

6. That toys for hospital use should be those that can be easily cleaned and can withstand many frequent cleanings; that are simple and easy to use, with few small parts to be lost; that are durable enough to survive active use by many different children, and that lend themselves to individual use.

7. That the toys most readily accepted and used for the longest times are those that are simple and can be used with a minimum amount of concentration or effort; that are in themselves suggestive of some play activity, and that can be used in a variety of ways.

8. That attractive and durable packaging contributes greatly to the desirability of a toy for hospital use.

Suggestions for Further Study

The present study, essentially an exploratory one, offers findings which show leads for further, more detailed studies, covering longer periods of time and a larger number of cases. Some of the further studies clearly implied in the findings, and which it is to be hoped will be undertaken, are suggested below:

1. What general uses can toys serve in a hospital?

This would be a continuation of the present study to discover more about the greatly varied general uses toys can serve in the hospital. In a further study it would be helpful to offer each of the toys to children of different ages observing more fully than has yet been done the differences in their use by children at different age levels.

2. What use do toys serve in keeping up patient morale?

Attention would be centered on patient morale, instances where it is likely to be low and use of toys can serve in keeping it up.

3. What toys are specifically indicated for children with special ailments, such as cerebral palsy, cardiac difficulties, arthritic conditions, etc.?

4. From the standpoint of doctors and nurses what are the advantages and disadvantages of toys as a part of a hospital's equipment?

This would be taken up from the standpoint of hospital routine and the usefulness of toys in accomplishing the purpose of the hospital.

5. What physical arrangements in the hospital are practical and best provide for the use of toys as a regular part of hospital equipment?

This would be included in hospital planning and would be a study of ways of storing the toys so that they could be used with a minimum demand on the nurse's time in getting them out and putting them away. It

would include arrangements for the children to use them in bed, arrangements of play space in the ward for ambulatory patients, perhaps planning a playroom, and arrangements for use in the clinic.

6. What units on the use of toys are included in nurse's training courses throughout the United States?

This would be a survey study.

7. What is the common practice in hospitals throughout the United States relative to (a) the provision of toys as a part of hospital equipment (b) the use of toys in the regular hospital routine?

Concluding Comments

The study herewith reported is only a bare beginning. However, it has disclosed possibilities in the use of toys in a hospital which, in the judgment of those associated with the study, have significance for the Hospital of Tomorrow, where toys will be considered an essential part of standard equipment. Those associated in this study also believe that further investigative study of the uses of toys in connection with the hospitalization or convalescence of children is much needed and will be very rewarding.

STANDARDS OF VARIATION IN THE ERUPTION OF THE FIRST SIX PERMANENT TEETH

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The establishment of norms and standards for various anthropometric variables pertaining to the teeth of children is still quite incomplete. Among the standards that still are lacking are those relating to the eruption of teeth. Although it can be argued that such standards would not fit perfectly any given child, it is self-evident that exact knowledge of the usual ranges of variation encountered would furnish convenient frames of reference for numerous biometric studies of individual children and groups of children. Such standards would be of value in attempts to interpret various reports which contain references to the clinical emergence of the teeth.

Several studies of rachitic and non-rachitic children have established the fact that at least one deficiency disease is generally accompanied by retardation of dental development. These studies remind the investigator of the necessity of being able to gauge tooth eruption in terms of small fractions of a year, rather than in terms of whole years. Therefore, since the physiologic processes which result in tooth emergence take place at a rapid rate when they do occur, it is imperative that the standards used are even more accurate than those which have to do with certain other growth phenomena, such as increases in body height and weight. A continuation of nutritional studies, as well as the development of broader programs dealing with constitutional types or a variety of pathological conditions, requires the establishment of best possible criteria for evaluating observations made on the teeth.

It became evident early in the course of this bibliographic study that presently available literature did not make the task of proper colligation easy. Not only were many of the best papers dealing with the time of eruption of the permanent teeth published in journals that are difficult of access, but the chief objective of the study made it absolutely necessary to review these papers in great detail. It was obvious that the standards derived would be of value only if they were based upon source material which met certain definite and reasonably exacting requirements.

Selection and standardization of data on the ranges of variation.

There were two main problems to be solved in attempting to summarize existing data on tooth emergence. The first of these had to do with the determination of the shapes of the frequency curves which give the cumulated percentages of erupted teeth at various age levels. The second important task was the selection of reports that could be used for calculating the mean and median ages of eruption of individual classes of teeth.

The first problem could be attacked only by determining what reports furnished figures that could be reduced to graphic form for describing

chronologic variations in the eruption of individual teeth. The reports selected had to furnish data covering at least one half of the age range during which a particular tooth crown is likely to make its debut into the external environment. The reports utilized for this purpose did not have to contain a definition of the term "eruption." It seemed safe to assume, after comparing several series of graphs representing data on teeth in various stages of eruption (i.e., graphs for teeth that are "just erupting," "in any stage of eruption," "fully erupted," etc.), that the shapes of the curves are not dependent to any appreciable degree upon the investigator's exact criteria of "eruption." This must not be taken to mean that careful studies in the future will not reveal statistical differences in the ranges of variation for different developmental stages of tooth emergence. The present study indicates only that if such differences do exist, they are of relatively small magnitude and of negligible importance in many biometric analyses. Therefore, the data were graphed on the presupposition that the average intervals between various stages of supragingival eruption are of equal magnitude at all age levels in a given group of children.

Lack of standardization of methods of recording and publishing data on eruption made the task of graphing the selected material a tedious process. Some authors, for instance, publish their figures for the right and left teeth separately, without presenting averages for the two sides. Some give the data in terms of the number of teeth observed, without computing any percentages. Some furnish the data for the two sexes separately, while others do not. Very few of the authors summarize their statistical material in a convenient graphic form. Much of the graphic material that is available is difficult of utilization on account of the poor planning or the diminutive size of the published graphs. The facts mentioned above give the reader some concept of the difficulties involved in forming a logically coherent assemblage of existing data on tooth eruption. The amount of work involved in preparing such data for further analysis can be appreciated even better if one remembers that from 21 to 29 separate standardization processings had to be completed for each one of the six permanent teeth discussed in this report.

The reports utilized for determining the frequency curves mentioned above varied in number from 14 for the mandibular first incisor to 18 for the maxillary first incisor. The sources of graphed data are listed in greater detail in Table I.

The problem of chronologic age.

The second main problem had to do with the determination of the chronologic ages of tooth emergence. Before this problem could be attacked successfully, it was necessary to find out what reports dealt with tooth eruption in an unambiguous manner. The difficulties encountered here were threefold.

In the final computations only those reports could be utilized which contained a reasonably clear indication of the meaning of the term "eruption" as used by the author. This seemingly simple requirement put the reviewer to much inconvenience, as very few of the publications provide the reader

TABLE I

A list of authors whose publications contain data that can be used for determining the cumulated percentages of teeth in any stage of eruption at various age levels.

AUTHOR, *with specification of data used*	FIRST MOLARS		FIRST INCISORS		SECOND INCISORS	
	Max.	*Mand.*	*Max.*	*Mand.*	*Max.*	*Mand.*
Berten (1895)	BG	M[1]	BG	M[1]	BG	BG
Bunting (1909)	M	M	M	M	M	M
Cartwright (1857)	M	M	none[2]	none[2]	none[2]	none[2]
Cattell (1928)	BG	BG	BG	BG	BG	BG
Chérot (1898)	M[1]	M[1]	M[1]	M[1]	M[1]	M[1]
Cohen (1928)	BG	BG	BG	BG	BG	BG
Cohen (1936)	M[1]	M[1]	M[1]	M[1]	M[1]	M[1]
Degerböl (1929-32)	insuf.	insuf.	BG	insuf.	BG	BG
Ekman (1938)						
rural children	insuf.	insuf.	BG	insuf.	BG	BG
Helsinki pub. school children	BG	BG	BG	BG	BG	BG
Förberg (1901)	insuf.	insuf.	BG	insuf.	BG	BG
James & Pitts (1912)	M	M	M	M	M	M
King (1940)	M	M	M	M	M	M
Klein, Palmer & Kramer (1937)	BG	BG	BG	BG	BG	BG
Medical Res'ch Council (1925)	none	B	B	none	none	none
Suk (1919)	B	insuf.	B	B	B	B
Unglaube (1924)	BG	M[1]	BG	BG	BG	BG
Wallis (1931)	BG	BG	BG	BG	BG	BG
Wuorinen (1926)	BG	BG	BG	BG	BG	BG
No. of sources of data	15	15	18	14	17	17
No. of graphs:						
Boys	9	7	13	8	12	12
Girls	8	6	11	7	11	11
Mixed groups	6	8	5	6	5	5
Totals	23	21	29	21	28	28

[1]Character of data unsuitable for meaningful separation on sex basis.

[2]Cartwright did not tabulate figures for first and second incisors separately.

with an easily located definition of the term. In many instances the only clue to be found was in an inconspicuous footnote, or in the discussion at the end of the article. In one or two cases the meaning of the term could be determined only by becoming thoroughly familiar with the contents of the entire article.

The manner of recording age, likewise, had to be carefully determined. To illustrate, some authors mean 6½ years when they write "6 years." Some express this by giving the age period, as "6 to 7 years," while others designate age by recording the midpoints of the periods. The age periods themselves vary in length from one report to another, ranging from 3-month intervals to one-year intervals. The definitions of "eruption" and the manner of furnishing the time data are given in Table II.

TABLE II

A list of authors whose publications contain information that can be used for determining the exact location of eruption curves along the time axis.

AUTHOR, *with specification of data used*	DEFINITION OF "ERUPTION"	LENGTH OF AGE INTERVALS (*months*)	AUTHOR'S DESIGNATION OF AGE INTERVALS
Bunting	"erupted or erupting"	6	midpoint
Cattell	"broken through the gums"	6	midpoint
Chérot	"apparition dans la bouche"	12	beginning
Cohen, 1928	"when cusps showed"	12	limits and midpoint
Cohen, 1936	not given, but presumably same as above	12	beginning
Degerböl	any stage of eruption, according to contents of report	3	limits
Ekman			
rural children	"jeder Zahn, der auch nur zu einem Teil das Zahnfleisch durchbrochen hatte"	12	beginning
city children		12	beginning
James & Pitts	"just erupting" and "present"	3	limits
Klein, Palmer & Kramer	"one mm. or more . . . . above gum"	12	beginning (6-7 yr. group = 6¾ yrs.)
Medical Res'ch Council.	"any stage of eruption"	3	midpoint
Suk	"erupted or erupting"	12	beginning
Wallis	"broken through the gums"	12	midpoint
Wuorinen	"gesprengt"	12	beginning

The third difficulty encountered in tackling the problem of chronologic age was that relating to the sex differences in the ages of eruption. Even a cursory survey of published data reveals the existence of much disagreement on this point between various authors. Table I, again, shows that the number of publications containing suitable data on eruption in *both* males and females is relatively small if the selection is confined to statistical material that can be graphed. Therefore, in order to augment the supply of basic data used for computing the average sex differences, the literature was searched for other tabulations which would give the sex differences either directly or indirectly.

Most of this additional material was found in the reports already listed in Table I. Regarding the reference furnished by the Medical Research Council of Great Britain (19), the sex differences were obtained from the tables on teeth "in any stage of eruption," other tables being ignored. But three additional sources of information were located. The data by Gebhart (14) on American-born children of Italian ancestry could be utilized by averaging the values for the right and the left teeth in the two sexes. Similarly, the data by Hellman (15) on Jewish-American boys and girls yielded useful figures when averages were computed from the values on "wealthy" and "poor" children. (Certain details concerning Hellman's material can be obtained only by consulting Gebhart's report.) Finally, an article by Steggerda and Hill (20) furnished carefully compiled statistical material, which could be made available in the same manner as Gebhart's tabulations. Only the data on white children were utilized.

Graphing of available statistical data.

After completing the bibliographic search for usable data and after finishing the preliminary standardization treatment of these data, graphs were constructed for all statistical material that could be reduced successfully to this form. Cumulated percentages of erupted or erupting teeth were represented by the ordinates of the points plotted, while the abscissae represented the time factors involved. When the plotting of points for a series of values for a given tooth was completed, a curve was drawn by the freehand method in such a way as to summarize as accurately as possible the trend suggested by the points. A trend line fitted by this method naturally "smooths out" all minor irregularities. As shown in Table II, the age intervals varied from three to twelve months in the publications. However, it was not found much more difficult to draw trend lines for points indicating 12-month intervals than for those indicating 3 or 6-month intervals. The freehand method of constructing integral curves of best fit was selected because it was felt that existing statistical data have not permitted the development of mathematical equations which describe the variation in tooth

emergence with absolute accuracy. The author is aware of the use of logistic curves of the form

$$Y = \frac{K}{1 + e^{a+bx}}$$

by certain investigators in Europe and the employment of the normal probability curve by Klein, Palmer and Kramer in the United States. There are no reasons for doubting the claims that the mathematical methods just mentioned furnish theoretical values which correspond surprisingly well with actually recorded values. Nevertheless, it still remains desirable to subject these mathematical approaches to critical evaluation. One of the purposes of the present study is to furnish biometricians with factual data with which various theoretically derived distributions can be compared.

Determination of sex differences.

The first step after graphing available numerical data consisted of finding out whether there were any consistent differences between the shapes of the frequency distribution curves obtained for males and females. This was important on account of the limited number of statistical studies published, especially since the usefulness of the graphs derived for mixed groups depended upon the non-existence of appreciable sex differences in variation. The results of this investigation, which was carried out separately for each one of the six teeth, indicated no noteworthy differences in the shapes of the curves for boys and girls. For this reason it was assumed, later, that the standard deviations for the sexes are approximately the same for a given class of teeth if the number of children examined is sufficiently large.

As stated on page 217, in order to compute the mean sex differences in the ages of tooth emergence, data from two principal sources were employed. The graphed material already described was one of the sources. If an author supplied data on eruption in both boys and girls, it was a simple matter to note the age difference between the points where the two "ogive" curves for a given tooth crossed the 50 per cent line. This (median) level was selected for making the determinations because, according to elementary theorems of probability, it is an established fact that such estimates are most reliable when they are based on values obtained from the middle ranges of distribution. Furthermore, as was pointed out in the preceding paragraph, no allowances had to be made for significant differences between the shapes of the curves for males and females. The second source of data on sex differences was furnished by tabulations which could not be reduced to graphic form. These data, and the data from graphs, were utilized for computing the figures shown in Table III.

TABLE III

Sex differences between ages of emergence of the first six permanent teeth and the variability of figures obtained from different sources.

(The values are given in decimals of a year.)

TOOTH	NUMBER OF SOURCES OF DATA	RANGE OF AGE INTERVALS	MEAN SEX DIFFERENCE ACCORDING TO		
			Tables	*Graphs*	*All Sources, with Standard Error*[1]
Max. M-1	16	0.07–0.33	0.19	0.17	0.18 ± 0.05
Mand. M-1	14	0.09–0.50	0.29	0.25	0.27 ± 0.08
Max. I-1	19	0.13–0.40	0.28	0.26	0.27 ± 0.06
Mand. I-1	15	0.16–0.38	0.30	0.26	0.28 ± 0.07
Max. I-2	19	0.38–0.70	0.46	0.48	0.47 ± 0.11
Mand. I-2	19	0.18–0.56	0.38	0.35	0.36 ± 0.08

[1] $S.E._{mean} = \pm \left(S.D. / \sqrt{N} \right) \sqrt{N/(N-1)}$

Table III gives one striking evidence of the variability of values obtained from data in different publications. There is, however, rather good correspondence between the mean values obtained from ungraphed material and those derived from graphed material. On the whole the "experimental errors" appear to be of almost equal magnitude for all six teeth. If the standard errors of the means are studied, one finds relatively little variation between them from one tooth to another. That for the maxillary second incisor is an exception, being 0.11 years, or 39 to 41 days.

The relative numbers of boys and girls in the tabulations for mixed groups were approximately the same, insofar as could be determined. (For certain details of data by Bunting (5) one must consult Bean (1).) In view of this, it was possible to convert the median ages of eruption for such mixed groups into median ages for males and females. Those for girls were obtained by subtracting one half of each established sex difference from the appropriate median age for a mixed group. Those for boys were obtained by adding the halved differences to the original values. In this study the median age of eruption was held to correspond to the point where a given frequency curve crosses the 50 per cent line of the graph.

Establishment of standards for median ages of eruption.

The completion of the preliminary procedures discussed above enabled one to commence the computation of the average median ages of eruption in males and females. By noting the points where the smoothed frequency curves cross the 50 per cent lines of the graphs, the median ages of tooth

emergence had been determined for each tooth in each sex for several groups of children. By eliminating the reports which did not contain an acceptable definition of "eruption," one could base the computations on the best available data. For example, all reports dealing exclusively with "fully erupted" teeth were disregarded. Only the reports listed in Table II were considered, as it was not felt wise to rely here on any statistical material which could not be evaluated *in toto* by an inspection of its graphic forms.

The final stages of this study had to be carried out on the assumption that the reports utilized for summarization were of equal mathematical worth. It was realized, of course, that this was not actually the case, despite the rigid selection of basic material. However, there was no way of evaluating the comparative biometric reliability of each separate item. All one could hope to accomplish was the establishment of averages which would be reasonably free of any serious distortions due to unavoidable "experimental (i.e., observational) errors." One would expect that since there would be a haphazard distribution of the more reliable and the less reliable basic age items along the time axis, the computed midpoint would represent the best possible compromise between them. The extreme values would cancel each other.

The results of these efforts to determine the most likely median ages of tooth emergence are brought together in Table IV. This table, like Table III, gives one a vivid picture of the surprising variability of figures obtained from different sources, although the data deal exclusively with Caucasians living in the northern temperate zone. Yet the standard errors of the averaged median ages show a remarkable degree of uniformity for all six teeth. Apparently there is almost no difference between the reliability of the available data on males and females, although those on males show slightly less variation than those on females. The median ages of tooth emergence are most securely established for the maxillary first incisor, with standard errors of only 0.04 and 0.05 years (i.e., $\pm$13 to 20 days). Some teeth, like the mandibular first incisor, have a standard error of 0.06 years (i.e., $\pm$21 to 23 days).

The median ages given in Tables IV and V represent correct values only for such eventually erupting tooth populations as correspond in number exactly or very closely to the child population samples examined. For five out of the six classes of permanent teeth discussed in this report the median age for a tooth population is the same as that for the child population. The maxillary second incisor is an exception to the rule, since about 2 per cent of the children never erupt the tooth. This means that 50 per cent of the teeth destined for eventual emergence will be present as soon as the tooth can be seen in the mouths of only 49 per cent of the children.

The last column of Table IV shows the average median ages after adjustments that make the sex differences correspond to those shown in the last column of Table III. In a few instances the averages computed from the items utilized for Table IV were one or two hundredths of a year more

TABLE IV

Median ages of tooth emergence, computed to nearest hundredth of a year.

Tooth		Number of Median Age Items Averaged	Range of Median Ages	Averaged Median Ages with Standard Errors[1]	Averaged Median Ages Adjusted to Show Established Sex Difference
Max. M-1	♀	10	5.99 – 6.53	6.25 ± 0.06	6.25
	♂	11	6.17 – 6.68	6.43 ± 0.05	6.43
Mand. M-1	♀	10	5.74 – 6.29	5.98 ± 0.06	5.97
	♂	10	6.01 – 6.51	6.23 ± 0.06	6.24
Max. I-1	♀	12	6.92 – 7.48	7.13 ± 0.05	7.13
	♂	14	7.20 – 7.65	7.40 ± 0.04	7.40
Mand. I-1	♀	10	5.98 – 6.68	6.18 ± 0.06	6.17
	♂	11	6.16 – 6.96	6.44 ± 0.06	6.45
Max. I-2	♀	12	7.80 – 8.52	8.11[2] ± 0.06	8.11
	♂	13	8.37 – 9.00	8.58[2] ± 0.06	8.58
Mand. I-2	♀	12	6.99 – 7.55	7.23 ± 0.05	7.24
	♂	13	7.34 – 7.87	7.61 ± 0.05	7.60

[1] $S.E._{mean} = \pm \left(S.D. / \sqrt{N} \right) \sqrt{N/(N-1)}$

[2] The median ages for the tooth populations destined for eruption are 8.09 and 8.56 years, for males and females, respectively.

or less than those shown in Table III. The amount of source material utilized for the computations summarized in Table III was more than that used for constructing Table IV. Since the sex differences given in the former table can be looked upon as more reliable than those represented by the averages in the latter table, it was felt advisable to make the adjustments shown in the last column of Table IV before proceeding with the determination of the mean ages of tooth eruption.

Summarization of graphed data on variation in eruption.

The determination of the mean ages of tooth emergence presented one of the most difficult tasks of the study. To begin with, it could not be as-

sumed that the median ages just computed would necessarily correspond with the mean ages of eruption. Broca (3, 4), the well-known French anthropologist, had objected at length in 1879 to the tendency to assume that the "probable age" of tooth eruption corresponds with the mean age of eruption. In fact, he wrote that he preferred mean age to probable age (called median age by Cournot, Bertillon and others), "because in calculating the latter, each case does not count except by its presence or absence in each half of the series" (i.e., above or below the 50 per cent line). Chérot (8), who utilized Broca's instructions for calculating the means and the medians in his statistical study in 1898, obtained results which indicated clearly the noncorrespondence between the two sets of figures. Without exception, the mean ages of tooth emergence either equalled or exceeded the probable, or median, ages of emergence.

Before the mean ages of tooth emergence could be calculated from the material compiled for the present analysis, it was necessary to summarize the frequency curves obtained previously. All of the curves had been drawn on the same scale on square-ruled, medium-weight drawing paper. By carefully transferring a small number (two, three, or four, as was convenient) of these curves to square-ruled tracing paper in such a manner that the median age points of the curves coincided perfectly, while there was equally accurate superimposition of the upper and lower base lines, it was possible to plot a continuous "average" curve for each small group of curves selected. The median age points were determined, as before, by noting where an individual curve crosses the 50 per cent line. Later, the "average" curves for the small groups were summarized by employing the same technique, care being taken to "weight" each separate curve with a value corresponding to the number of basic items that it represented. By employing this method it was possible to "add" together all cumulative frequency curves for each class of teeth in each sex without recourse to time-consuming mathematical computation.

The process of summarizing the individual frequency curves for each morphological class of teeth brought out some facts of importance. It was mentioned earlier, on page 218, that no appreciable sex differences could be found in the ranges of variation. In the case of every one of the six permanent teeth studied, the shape of the curve obtained by "adding together" all available integral curves for boys was an almost exact duplicate of the corresponding curve obtained for girls. Therefore, in preparing the graphs accompanying this report, the same six cumulative frequency curves were used for both sexes. The only difference between the sexes concerned the location of the standard curves on the abscissa or time axis.

One of the most unexpected results of the analysis was the full revelation of the paucity of reliable data on the emergence of permanent teeth in children under 5½ years of age. Table I gives the reader but incomplete indication of the present dearth of adequate statistical information on the eruption of both first molars and the mandibular first incisor in children who

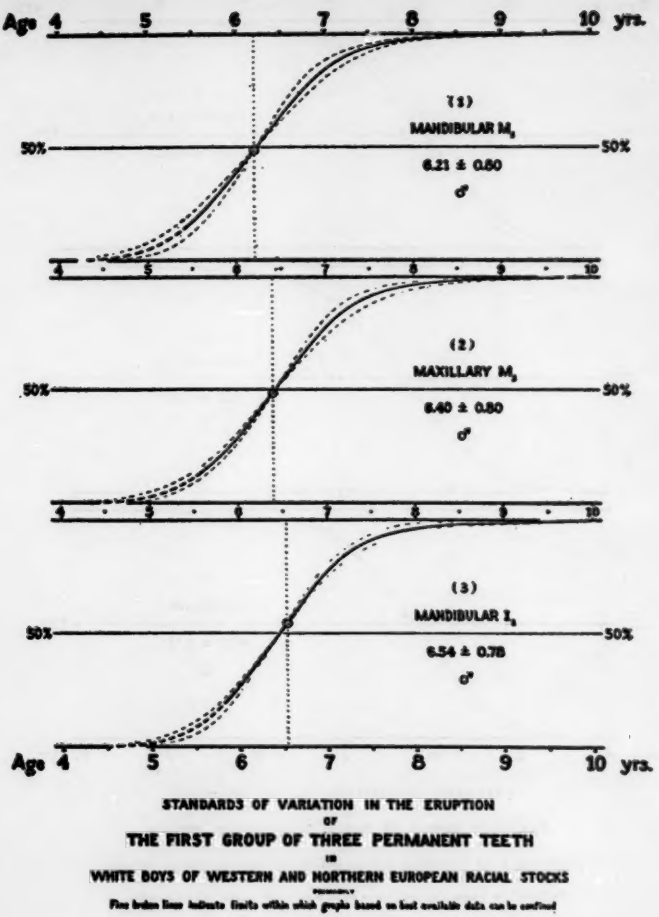

FIGURE 1

erupt these teeth early. Actually, the number of graphs covering children between 4 and 5½ years of age is very much smaller than the total numbers given at the bottom of Table I. The discrepancy between the number of individual curves that can be "summed up" at each end of the ranges of variation is very marked. Consequently it is not surprising that quite

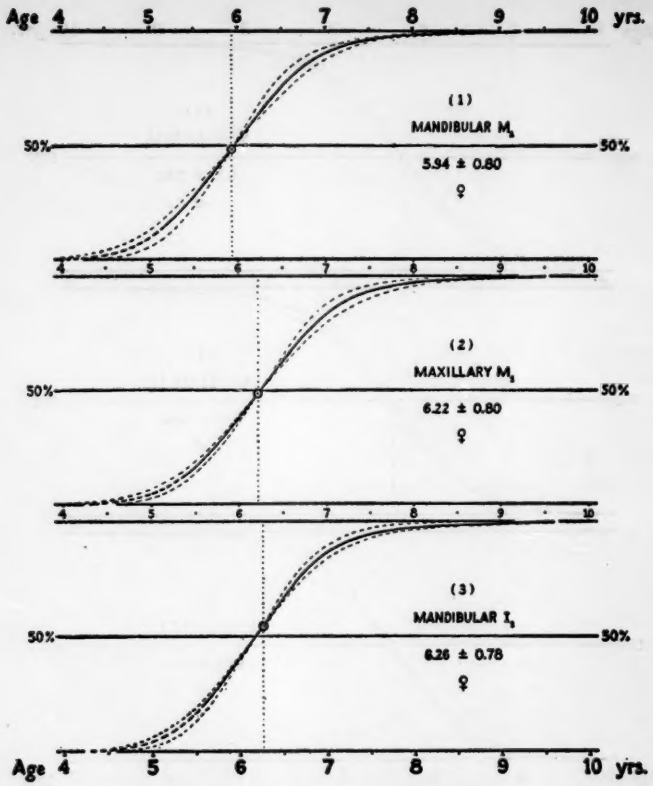

FIGURE 2

irregular or even discontinuous curves are obtained by averaging without selection the meager graphic data relating to the age period mentioned above.

In order to overcome the difficulties encountered in trying to plot the average cumulative frequency curves for early eruptors, recourse was had

to an indirect method of attack. It was known that all complete graphs for various classes of teeth showed a high degree of likeness between the two halves of a curve. The curves which represented actually recorded clinical data were very similar to symmetrical logistic curves obtained mathematically; in both cases the curvature in the first half of a given frequency diagram being comparable with the curvature in the second half of the same diagram. There was no reason whatever for believing that the three teeth referred to in the preceding paragraph had integral curves differing in character from those of the other permanent teeth. Therefore, it appeared feasible to determine the probable shapes of the lower sections of their standard curves by utilizing for summarization only such graphic material as appeared suitable for the purpose. The summarizing was limited to the few complete or nearly complete individual curves whose middle and upper sections resembled the corresponding sections of the curves obtained by averaging all available graphic data on the three teeth. Finally, in order to indicate that a certain amount of guesswork was necessary in determining the exact forms of these three curves, heavy broken lines were used in drawing the less securely established lower portions shown in Figures 1 and 2.

The third important point brought out by the summation of available graphic material was the consistent asymmetry of the curves. Although, as stated previously, the curves which result from a plotting of actual observational data are very similar to symmetrical logistic curves, this similarity is by no means as close as certain published analyses would lead one to believe. Furthermore, the degrees of asymmetry of the frequency distributions vary for the different classes of teeth. In the case of each of the six permanent teeth studied the proportion of curve above the 50 per cent line is noticeably more than that below the same level. Concomitantly the curvatures above the points of inflection are invariably less sharp than those below, as can be seen by studying Figures 1, 2, 3 and 4.

Another point brought out in the course of this comparative study concerns the remarkable degree of similarity between the shapes of individual graphic curves drawn for the same tooth. It is to be remembered that the individual curves represent data collected on widely-scattered white population groups in the northern temperate zone at different periods of time. The seventeen authors listed in Table I represent eight different countries. The eighteen reports produced by them appeared at irregular intervals between the years 1857 and 1940. Notwithstanding the wide divergence between the various sources of data, the individual curves for a given tooth vary rather little from each other in form.

This fact can be demonstrated visually by drawing for each tooth the limits of a zone which could contain the separate curves if these were superimposed so that their median age points (or points of inflection) coincided. The fine broken lines on each side of the curves shown in Figures 1, 2, 3

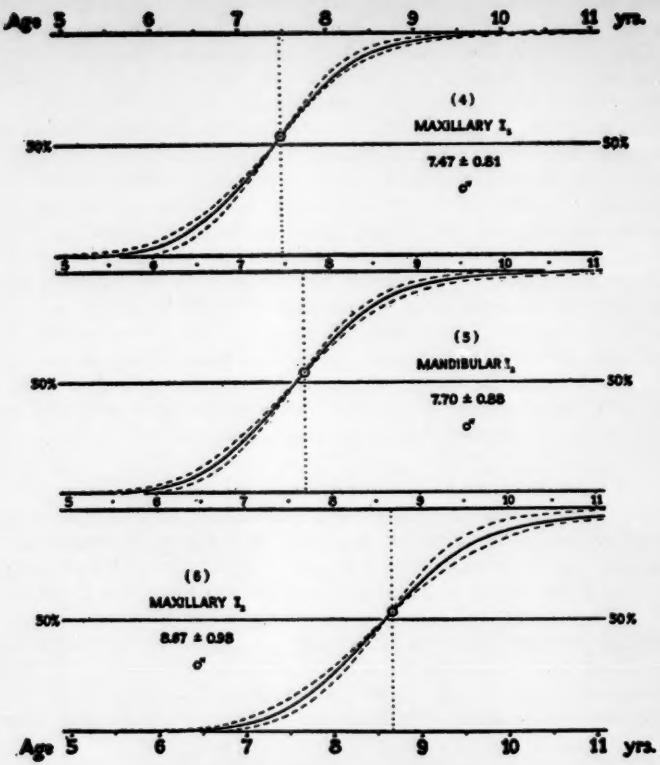

FIGURE 3

and 4 indicate such limits.[1] The zones shown in the diagrams are very narrow for some teeth, among which the mandibular first and second in-

[1]The graphs representing Bunting's data on the three teeth shown in Figures 1 and 2 were omitted in drawing the zone limits. These graphs differed so markedly from the general pattern of all other graphs that they were suspected of representing statistically questionable observations.

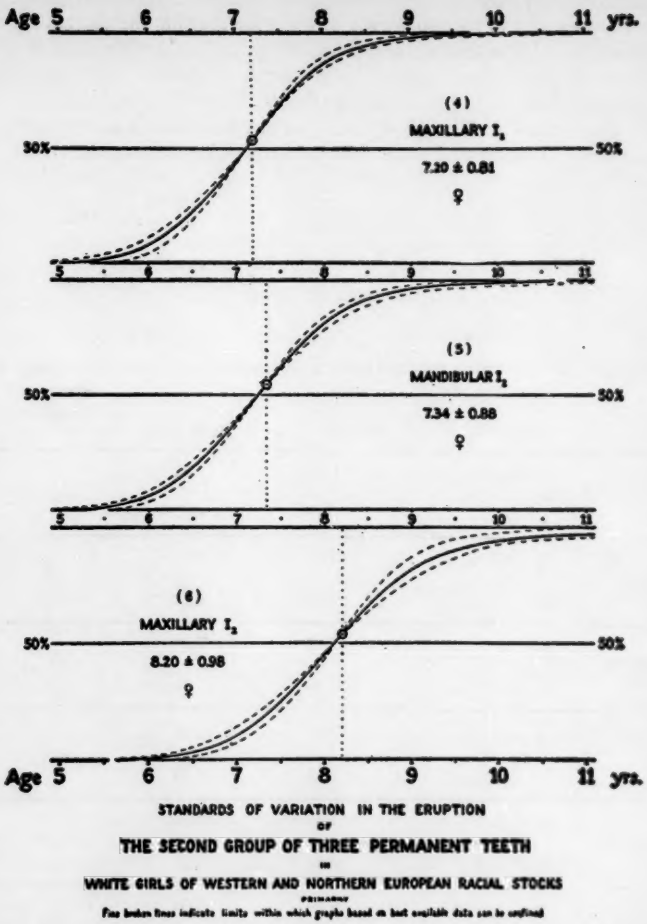

FIGURE 4

cisors are the most conspicuous. The greatest disagreement regarding the shape of the eruption curve centers around the maxillary second incisor.

The fifth interesting by-product of the curve summarization process has to do with the same tooth, to wit, the maxillary second incisor. Figures 3 and 4 do not show the cumulative frequency curve for this tooth reaching

the 100 per cent line, as do all of the other standard curves. This failure is not due entirely to an insufficiency of space for drawing the diagram. The massed statistical evidence indicates beyond any doubt that there is fairly frequent agenesis and nonemergence of the organ in question. The curve that represents an averaging of 28 individual items levels off at, or slightly above, the 98 per cent line. Thus about 2 per cent of white children of western and northern European racial stocks fail to either develop or erupt the tooth.

TABLE V

Median and mean ages of tooth emergence, with computed[1] *standard deviations.*

(The values are expressed decimally, in terms of years.)

Tooth		Median Ages	Mean Ages	Standard Deviations *(for both sexes)*
Max. M-1	♀	6.25	6.22[2]	0.80[3]
	♂	6.43	6.40[2]	
Mand. M-1	♀	5.97	5.94[2]	0.80[3]
	♂	6.24	6.21[2]	
Max. I-1	♀	7.13	7.20	0.81
	♂	7.40	7.47	
Mand. I-1	♀	6.17	6.26	0.78
	♂	6.45	6.54	
Max. I-2	♀	8.11[4]	8.20	0.98
	♂	8.58[5]	8.67	
Mand. I-2	♀	7.24	7.34	0.88
	♂	7.60	7.70	

[1]Computation is specified to indicate that the standard deviations were not derived by using probability paper, or other indirect methods.

[2]Probably somewhat too low.

[3]Probably one or two hundredths of a year too high.

[4]Median age for tooth population destined for eventual emergence is 8.09 years.

[5]Median age for tooth population is 8.56 years.

Establishment of standards for mean ages of eruption.

The completion of the tasks described above made it possible, finally, to calculate the mean ages and standard deviations of tooth emergence. The system of procedure developed by Broca was used. The numerical data needed were obtained from large-scale diagrams showing the standard curves for each tooth. The age classes employed were on the basis of tenths of a year; the hypothetical number of individuals considered was 1,000 in all cases except one. The exception concerned the maxillary second incisor, for which tooth the hypothetical number employed was 980.[2]

The means and their standard deviations are given in the diagrams (Figures 1, 2, 3 and 4) and in Table V, which brings these data together with the median ages already computed. The mean ages of eruption are seen to be generally higher than the median ages. In the case of two teeth the difference is as much as one tenth of a year. As was mentioned earlier, Chérot found similar differences between mean and "probable" ages.

The first molar figures on means and medians form an exception to the general rule. The mean ages of eruption for these teeth are 0.03 of a year lower than the median ages. It is quite likely that this exceptional sequence is due to the insufficient quantity of reliable data that could be obtained for determining the exact shapes of the lower parts of the cumulative frequency curves for these teeth. Future investigations may show that these curves should be somewhat steeper than the ones shown in Figures 1 and 2. In that case the mean age points would shift slightly to the right (perhaps even above the 50 per cent line), while the standard deviations would come out less than 0.80 of a year.

Summary

1. Lack of summarized data on the eruption of permanent teeth has forced anthropologists and students of child development to contend with a number of disharmonious tabulations. The degrees of agreement and disagreement between various publications have been unknown.

2. This report furnishes a synthesis of the best available data on the emergence of the first six permanent teeth in boys and girls living in the northern temperate zone. The material analyzed and summarized represents western and northern European ethnic groups almost exclusively.

[2]Due to the fact that a few individuals in any large population group fail to develop one or more of their permanent teeth, no frequency curve should actually reach the 100 per cent level. With the exception of the maxillary second incisor tooth the percentages of agenesis and nonemergence are so small for the other five classes of teeth discussed in this paper that no serious errors result from ignoring them.

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NEWS NOTES

A clearinghouse for research in child life.

A clearinghouse for research in child life has recently been established in the Children's Bureau, of the Social Security Administration, Federal Security Agency, as an aid to research workers in keeping abreast with studies in progress. Lack of a place where investigators could find out about current projects in their own fields, or related ones, has been a handicap to many in the past. The clearinghouse will provide a systematic way to keep professional people informed about research in progress, and to bridge the time-gap between completion and publication of work.

The establishment of a clearinghouse in the Children's Bureau grew out of a series of conferences held during the past year to review what is going on in research in child life, what the gaps are, and how the needs for research can be met. Representatives of many fields in child life research participated in one or more of these conferences.

The clearinghouse will canvass investigators in various fields for reports of studies in progress, including collections of unpublished data. A bulletin will be released in 1949 containing information about current research in child life.

Information will be provided to research workers on request, but the Children's Bureau emphasizes that the clearinghouse will not attempt to summarize or indicate the conclusions of research projects, but will furnish accounts of the nature of projects as reported to it by individuals or organizations. Participation will be voluntary, but it is hoped that cooperation will be extensive, as the value of the clearinghouse will be dependent upon its scope and coverage.

Inquiries may be directed to Dr. Clara E. Councell, Director, Clearinghouse, Children's Bureau, Federal Security Agency, Washington 25, D.C.

Nation-wide survey of child posture.

The Federal National Fitness Council of Australia is sponsoring a nation-wide survey in Australia to determine the incidence of postural defects in school children, and to discover age trends. This survey was undertaken in response to requests made by the supervisors in physical education from the six states and from representatives of the School Medical Services.

Dr. Edith Clement, an officer of the New South Wales School Medical Service, was appointed to take charge of the work, together with a non-medical research officer. All of the states have been visited, and to date 30,000 children have been examined. Two-day instructional courses for the Physical Education Staff were conducted in each state. A series of photographs of children at ages 7, 10, and 13, showing certain defects and degrees of defects were used in the lectures to such staff. Children of different

type builds were selected for the pictures and examiners were taught to look at the position of the head and shoulders, the thoracic and lumbar spine seen in a lateral view, knock knee, overcarriage, and total posture, and to identify deviations from the normal in these positions.

The study has been especially interested in adolescent kyphosis. An incidence of 3½ per cent kyphosis has been found so far, and it is hoped that by the end of the investigation some conclusions will be reached regarding its cause and remedy.

The results are still being tabulated so that findings of the survey have not yet been reported, but it is the hope of those conducting the study, that remedial exercises for different age groups can be evolved as a result of the findings.

Inventory of research in race relations.

The Committee on Education, Training and Research in Race Relations of the University of Chicago, in cooperation with the American Council on Race Relations, is conducting an inventory of research in race relations and minority group problems, in order to make available information on current research which will be of value to persons and agencies carrying on research and also to those engaged in action programs in the field. It is planned to issue quarterly bulletins describing current and recently completed research projects. The inventory bulletins carry accounts of two kinds: (1) descriptions of studies reported in answer to the inventory questionnaire and (2) abstracts of studies contained in published articles, pamphlets and books. All those who are engaged in research in racial and cultural relations are invited to write to the Committee for the inventory questionnaire. The address is Committee on Education, Training and Research in Race Relations, The University of Chicago, 4901 Ellis Avenue, Chicago 15, Illinois.

Cross-disciplinary introductory course.

The Carnegie Corporation of New York recently announced that it had made a grant of $13,500 to Northwestern University to assist in the development of a joint introductory course, to be entitled "An introduction to the sciences of human behavior," covering the fields of anthropology, psychology and sociology. The aim of the course is to coordinate the essential concepts and materials normally presented in the separate introductory courses of the respective fields.

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Child Development, one of three publications issued by the Society for Research in Child Development, is devoted to brief papers of current research in the child field. The journal is issued quarterly in March, June, September and December. The subscription price is $6.00 per year, postpaid. A limited supply of back issues is available at $1.25 per number. Until the supply is exhausted, complete sets, Volumes 1 to 18 inclusive, may be obtained for $39.00.

Other publications of the Society include *Child Development Abstracts and Bibliography* and *Monographs of the Society for Research in Child Development.*

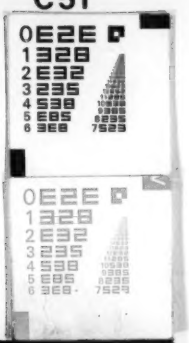
Child Development Abstracts and Bibliography, now in its twenty-first yearly volume, is issued February through December—six numbers to a volume. The subscription price is $5.00 per year, postpaid.

Monographs of the Society for Research in Child Development, issued irregularly during the year, consist primarily of detailed critical reviews and seriatim studies. The subscription price is $4.00 per yearly volume.

The three publications of the Society are available at the special price of $12.00 per year.

Correspondence relating to articles and papers for publication in *Child Development* should be sent to Dr. Carroll E. Palmer, Society for Research in Child Development, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

Correspondence relating to studies for publication in the Monograph Series should be sent to Dr. L. W. Sontag, The Samuel S. Fels Research Institute, Antioch College, Yellow Springs, Ohio.

Correspondence relating to subscriptions and business matters for all publications should be sent to the Editorial Office, Society for Research in Child Development, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

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